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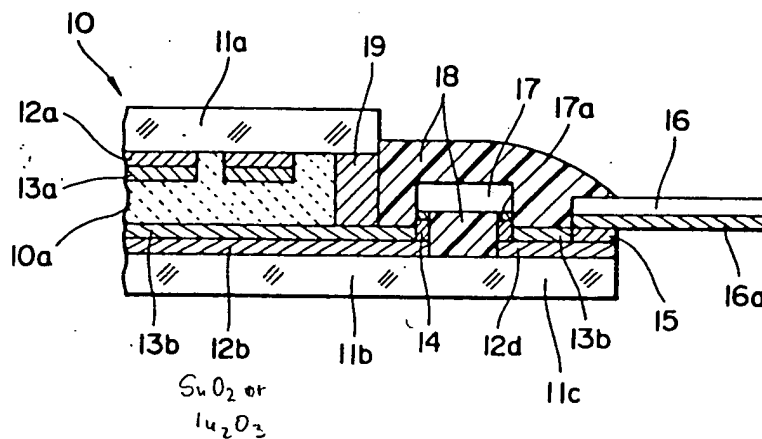
(58) Field of search

G5C  
H1K

(54) Liquid crystal display device

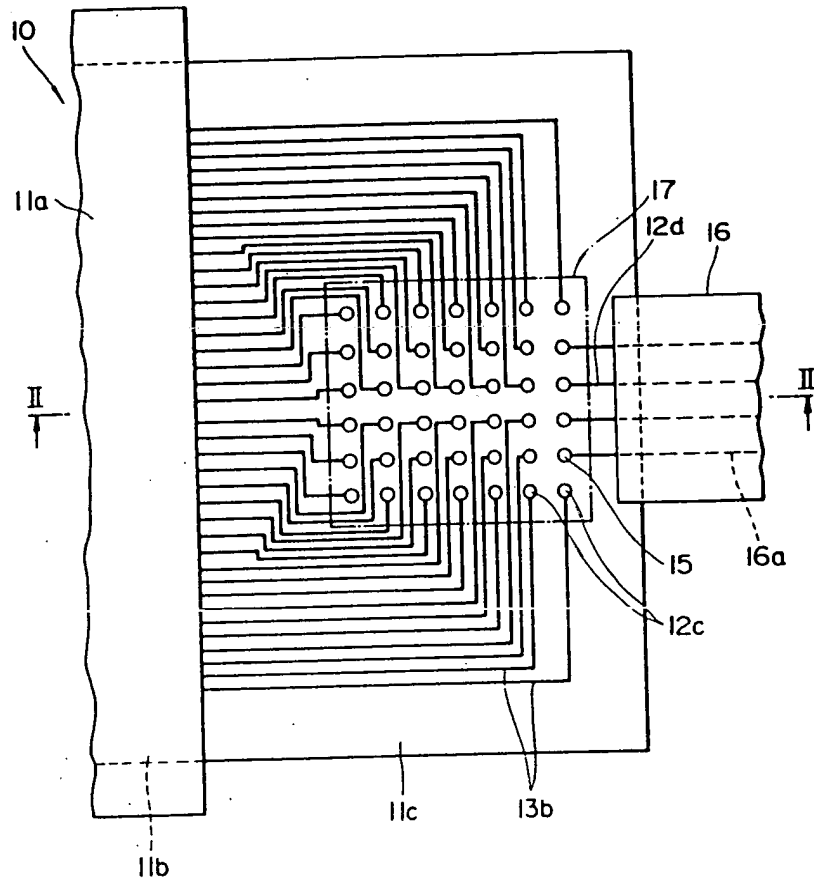
(57) An IC chip 17 is connected to terminal portions of conductive films on a lower substrate of a liquid crystal display panel by face down bonding. The IC chip and conductive films are coated at 18 with resin to protect the IC chip and films. The terminals on the IC chip are connected via conductive adhesives 17a made of epoxy resins including silver powder. Leads 16a connect the IC chip 17 to outside circuits. The resin material applied below the IC chip may differ in characteristics from that applied over it.

FIG. 2



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FIG. 1



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FIG. 2

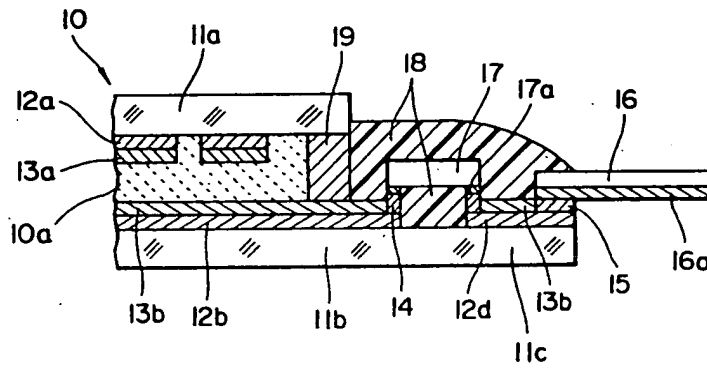
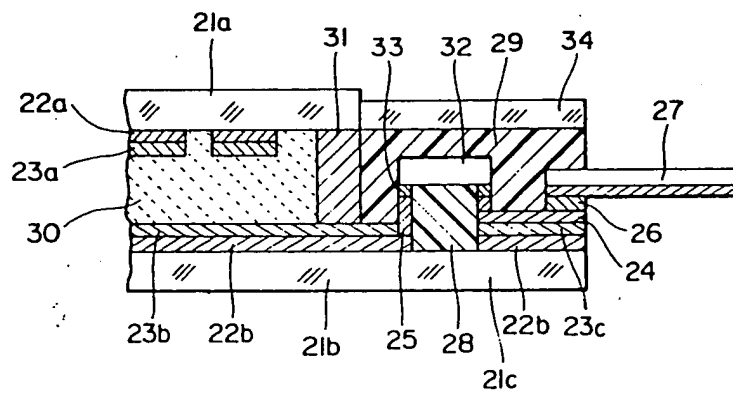


FIG. 3



## SPECIFICATION

## Liquid crystal display device

5 The present invention relates to a liquid crystal display device, and more particularly to a structure for connecting a liquid crystal display panel to an integrated circuit (IC) for driving the display panel.

10 Since the liquid crystal display device can be driven by low voltage and low electric power, it is of advantage to a small portable electronic equipment such as electronic wristwatch, television receiver, and others. In order to provide a small portable electronic equipment, it is necessary to connect the IC (including LSI) to the liquid crystal display device by terminal dispositions of high density, and it is desirable to mount the IC on a substrate for electrodes of a liquid crystal display panel.

Conventional methods for connecting a liquid crystal display panel and the IC are as follows:

- 25 (1) A packaged IC is mounted on the electrode substrate by soldering.  
 (2) An IC chip is disposed on a substrate and electrically connected to electrodes by wire bonding.  
 30 (3) After an IC chip is electrically adhered to electrodes by conductive adhesives, the IC chip is protected by a cap.

However, these methods have disadvantages. The first method is improper to provide a compact device of high density, because of the packaged IC. By the second method, an IC chip provided with a two-dimensional pad disposition can not be employed because of limitation by wire bonding method per se. In the third method, the cap method has an inherent problem. The water vapor inevitably stays in a space between the IC chip and the cap, which causes the corrosion of wirings of circuitries. In order to prevent the corrosion, the substrate and cap must be sealed by a hermetic seal. However, the temperature applied to the liquid crystal display panel having liquid crystal material must be maintained below 150°C in order to prevent the deterioration of the material, which means difficulty of the hermetic seal.

The object of the present invention is to provide a structure for connecting a liquid crystal display panel to an IC chip by face down bonding, whereby providing a device having high reliability, productivity, and a high density terminal disposition.

According to the invention, there is provided a liquid crystal display device comprising a liquid crystal display panel having upper and lower substrates, conductive films provided on the underside of the upper substrate and on the lower substrate, the lower substrate having a larger size than the upper substrate to form a connection portion.

In accordance with the present invention, terminal portions are formed on the connecting portion of the lower substrate and electrically connected to the conductive films on the lower substrate, and an electric circuit element having terminal portions on the underside thereof is connected to the terminal portions on the connecting portion through conductive adhesives. The electric circuit is covered by a nonconducting coating provided on the lower substrate.

These and other objects and features of the present invention will become more apparent from the following description with reference to the accompanying drawings, in which:—

Figure 1 is a plan view of a part of a liquid crystal display device according to the present invention, in which a resin coating and an IC chip are omitted for the convenience of illustration.

Figure 2 is a sectional view taken along line II-II of Fig. 1; and

Figure 3 is a sectional view partly showing another embodiment of the present invention.

Referring to Figs. 1 and 2 showing a connecting structure for a liquid crystal display panel 10 and an IC (or LSI) chip 17 by face down bonding, the liquid crystal display panel comprises a transparent upper substrate 11a and a transparent lower substrate 11b. The upper and lower substrates are shaped to form a connecting portion 11c on the lower substrate. Each of substrates 11a and 11b is made of sodium glass, borasilicate glass, lead glass, or organic glass such as polyethersulfone, polysulfone, polycarbonate or acrylic resin. A plurality of transparent conductive films (electrodes) 12a and 12b made of SnO<sub>2</sub> or In<sub>2</sub>O<sub>3</sub> are secured to inner surfaces of substrates 11a and 11b, respectively. The conductive films 12b extend from the display panel onto the connecting portion 11c. Leads 13a and 13b are disposed on the conductive films 12a and 12b in order to reduce electrical resistivity of the films. The leads 13a and 13b are made of conductive material, such as chromium, nickel, nickel phosphate, copper, gold or carbon, and formed by thick film, thin film or plating. Liquid crystal material 10a is sealed between upper and lower substrates 11a and 11b by sealing members 19 made of epoxy resin.

IC chip 17 is disposed on the conductive films 12b on the substrate 11b and pads 17a on the underside of the IC chip are electrically connected to terminal pads 12c (Fig. 1) of the films 12b through conductive adhesives 14. The conductive adhesives 14 is made of epoxy resin including silver powder. The adhesives 14 is formed on surfaces of one of pads on IC chip 17 and on the terminal pads 12c or on both pads by screen printing or transfer printing, and serves to join the IC chip 17 and films 12b with each other. If the leads 13b are gold, the adhesives 14 are directly se-

both terminal portions with each other; and  
a nonconducting coating provided on the  
connecting portion covering the IC chip.

2. The liquid crystal display device accord-  
5 ing to claim 1 further comprising leads pro-  
vided on the conductive films.

3. The liquid crystal display device accord-  
ing to claim 1 wherein the nonconducting  
coating is provided to further cover conductive  
10 films on the connecting portion.

4. The liquid crystal display device accord-  
ing to claim 1 wherein the space between the  
IC chip and the lower substrate is filled with  
resin different from the outside coating in  
15 characteristic.

5. A liquid crystal display device substan-  
tially as hereinbefore described with reference  
to, and as illustrated in, Figs. 1 and 2 or Fig.  
3 of the accompanying drawings.

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